Internship / Student Assistant / Bachelor thesis / Master thesis / Diploma thesis

Levitating liquid metal drops in ferrofluid: magnetic levitation and X-ray imaging

Magnetic levitation is fascinating: an object floats freely, seemingly as if by magic. Physically speaking, the weight force of the object is compensated by an opposing magnetic force. This principle is used, for example, in magnetic levitation trains, which can reach high speeds thanks to the contact-free drive system. We investigate magnetic levitation in liquids using laboratory-scale experiments. In addition to the magnetic properties of the levitating object and the surrounding liquid, hydrodynamic effects also play an important but as yet insufficiently understood role.

This student project is concerned with the experimental investigation of magnetic levitation in a liquid-liquid two-phase system. In particular, we investigate the behaviour of a liquid metal drop in a ferrofluid under an applied magnetic field. The liquid metal we are working with is a low-melting gallium alloy, which is liquid at room temperature. A ferrofluid is a liquid that reacts to magnetic fields as nanometre-sized magnetic particles are suspended in the carrier liquid. Both, liquid metal and ferrofluid, are opaque to visible light. We therefore use X-rays for imaging measurements. We aim to observe the motion and measure the velocity of the liquid metal drop in the ferrofluid when the drop approaches the applied magnetic field. The measurement results will be compared with similar levitation experiments in other liquid-liquid and solid-liquid two-phase systems, thus contributing to a better understanding of the hydrodynamic effects and magnetic forces acting in such systems.

The following subtasks are mainly to be worked on:

- assistance in preparing and performing the experiment in the X-ray laboratory at HZDR
- analysis of the measurement data, including image processing and machine learning if applicable
- documentation of the experiments and measurement results in written form

Requirements

- field of study: process engineering, fluid mechanics, or similar focus in chemistry or physics
- experiences with laboratory work and data analysis, particularly image processing, are beneficial (e.g. using ImageJ, MATLAB, Python)
- high motivation and interest in the subject
- careful, structured and independent way of working
- good oral and written communication skills in English or German
- enjoyment of scientific work

Conditions

- working in a multi-disciplinary and international team
- place of work: HZDR (X-ray laboratory) and TU Dresden
- start: from April 2024
- duration: min. 3 months
- remuneration according to HZDR internal regulations

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